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Rh(III)-Catalyzed Oxidative Annulation of Sulfoximines with Arylalkynyl Silanes via Desilylation

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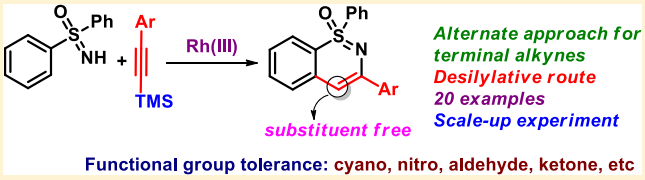
Supporting Information

ABSTRACT: Rh(III) catalyzed oxidative synthesis of 1,2-benzothiazine derivatives using sulfoximine as a directing group under C−H activation strategy is reported. In this study, we utilized arylalkynyl silanes as an alternate for terminal alkynes to obtain the 1,2-benzothiazine derivatives via desilylation pathway. The developed methodology shows a good range of functional group tolerance and furnished the products in moderate yields.



Sulfoximines are important structural scaffolds found in many natural products and medicinally important compounds.[1] 1,2-Benzothiazines can also be described as cyclic sulfoximines, which are useful synthetic scaffolds found in many medicinally important molecules.[2] 1,2-Benzothiazines are nonaromatic benzofused heterocyclic compounds containing sulfur, nitrogen, and a stereogenic center. High molecular complexity and the presence of stereogenic atom in 1,2-benzothiazines is responsible for their medicinal activities.[3] This class of compounds acts as peptido mimetic inhibitors. They can inhibit Calpain-I enzyme, which is responsible for neurodegenerative disorders including stroke, traumatic brain injury, spinal cord trauma, Alzheimer's disease, Parkinson's disease, multiple sclerosis, motor neuron damage, and muscular dystrophy (Figure 1).[4] Despite such profound

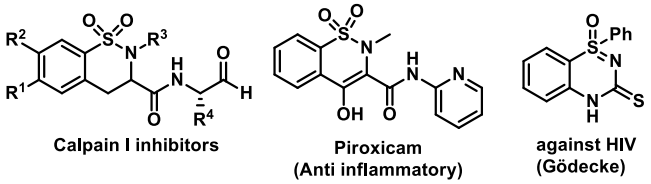
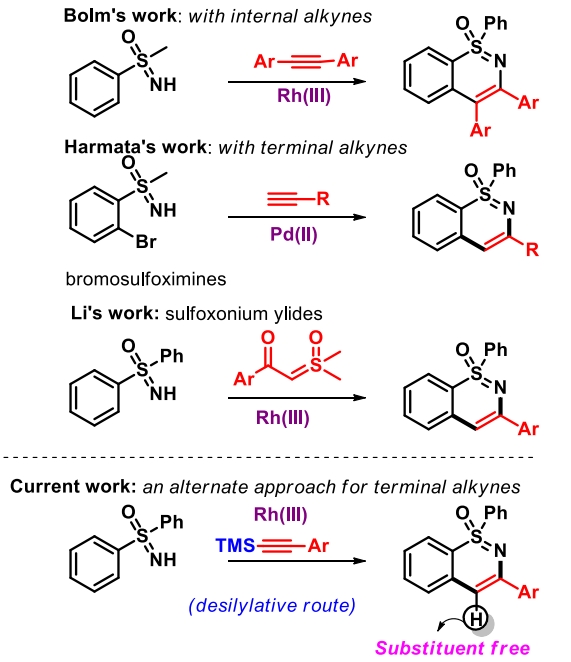


Figure 1. Selected examples of medicinally important molecules having 1,2-benzothiazine scaffold.

medicinal importance, meager attention has been paid to these molecules since their discovery in 1973 by Williams and Cram due to the synthetic challenges associated with them.[5]

Harmata's group used Pd-catalyzed Sonogashira cross-coupling reaction between 2-bromo sulfoximines and terminal alkynes followed by cyclization to obtain the 1,2-benzothiazine.[6] Although this is an efficient strategy, prefunctionalized sulfoximines such as bromosulfoximines were necessary for this transformation (Scheme 1). To avoid prefunctionalization, simplified and step economical methods are desired. Bolm's group addressed this problem using Rh-catalyzed C−H activation method for synthesizing 1,2-benzthiazenes using

Scheme 1. Comparison with Previous Work



unfunctionalized sulfoximines (Scheme 1).[7] In this report, they have utilized internal alkynes as coupling partners to obtain the corresponding 1,2-benzothiazines derivatives. This C−H activation strategy to obtain 1,2-benzthazine derivatives finds a greater attention in the field of organic synthesis. However, many groups, including Bolm's group, have utilized sulfoximine as a directing group under C−H activation strategy for annulation reactions for constructing 1,2-benzothiazene derivatives using internal alkynes,[7] diazo compounds,[8a,b] allyl

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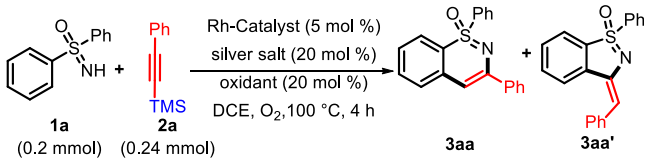
Table 1. Optimization Studies[a]



entry	Rh catalyst (5 mol %)	silver salt (20 mol %)	oxidant (20 mol %)	additive (equiv)	solvent (2 mL)	NMR yield (%)[b] 3aa	3aa′
1[c]	$[RhCp^*Cl_2]_2$	$AgSbF_6$	$Cu(OAc)_2{\cdot}H_2O$	none	DCE	nd	nd
2	$[RhCp^*Cl_2]_2$	$AgSbF_6$	$Cu(OAc)_2{\cdot}H_2O$	none	DCE	49	7
3	$[RhCp^*Cl_2]_2$	$AgSbF_6$	$Cu(OAc)_2{\cdot}H_2O$	none	toluene	55	8
4	$[RhCp^*Cl_2]_2$	$AgSbF_6$	$Cu(OAc)_2{\cdot}H_2O$	none	TFE	35	3
5	$[RhCp^*Cl_2]_2$	$AgSbF_6$	$Cu(OAc)_2{\cdot}H_2O$	none	1,4-dioxane	54	8
6	$[RhCp^*(MeCN)_3][SbF_6]_2$	none	$Cu(OAc)_2{\cdot}H_2O$	none	toluene	48	5
7	$[Cp^*Rh(CH_3CN)_3][BF_4]_2$	none	$Cu(OAc)_2{\cdot}H_2O$	none	toluene	42	4
8	$[RhCp^*Cl_2]_2$	$AgBF_4$	$Cu(OAc)_2{\cdot}H_2O$	none	toluene	49	4
9	$[RhCp^*Cl_2]_2$	$AgNTf_2$	$Cu(OAc)_2{\cdot}H_2O$	none	toluene	51	6
10	$[RhCp^*Cl_2]_2$	$AgSbF_6$	$Fe(OAc)_2$	none	toluene	38	trace
11	$[RhCp^*Cl_2]_2$	$AgSbF_6$	AgOAc	none	toluene	26	3
12	$[RhCp^*Cl_2]_2$	$AgSbF_6$	$Cu(OAc)_2{\cdot}H_2O$	NaOAc (1)	toluene	58	10
13	$[RhCp^*Cl_2]_2$	$AgSbF_6$	$Cu(OAc)_2{\cdot}H_2O$	AcOH (1)	toluene	25	6
14	**$[RhCp^*Cl_2]_2$**	**$AgSbF_6$**	**$Cu(OAc)_2{\cdot}H_2O$**	**H_2O (10)**	**toluene**	**65**	**7**
15[d]	$[RhCp^*Cl_2]_2$	$AgSbF_6$	$Cu(OAc)_2{\cdot}H_2O$	H_2O (10)	toluene	48	5
16[e]	$[RhCp^*Cl_2]_2$	$AgSbF_6$	$Cu(OAc)_2{\cdot}H_2O$	H_2O (10)	toluene	56	8
17[f]	$[RhCp^*Cl_2]_2$	$AgSbF_6$	$Cu(OAc)_2{\cdot}H_2O$	H_2O (10)	toluene	35	6
18[g]	$[RhCp^*Cl_2]_2$	$AgSbF_6$	$Cu(OAc)_2{\cdot}H_2O$	H_2O (10)	toluene	50	9
19	$[RhCp^*Cl_2]_2$	$AgSbF_6$	none	H_2O (10)	toluene	20	2
20	$[RhCp^*Cl_2]_2$	none	$Cu(OAc)_2{\cdot}H_2O$	H_2O (10)	toluene	nd	nd
21[h]	$[RhCp^*Cl_2]_2$	$AgSbF_6$	$Cu(OAc)_2{\cdot}H_2O$	H_2O (10)	toluene	39	7

[a]Reaction conditions: **1a** (0.2 mmol), **2a** (0.24 mmol), $[RhCp^*Cl_2]_2$ (5 mol %), $AgSbF_6$ (20 mol %), $Cu(OAc)_2{\cdot}H_2O$ (20 mol %), solvent (2 mL) at 100 °C for 4 h. [b]^1H NMR yield (using terephthalaldehyde as an internal standard). [c]Phenylacetylene was used instead of **2a**. [d]1 equiv of $Cu(OAc)_2{\cdot}H_2O$. [e]7.5 mol % of $[RhCp^*Cl_2]_2$. [f]At 80 °C. [g]At 120 °C. [h]In open air.

carbonates,[8c] sulfoxonium ylides[8d,e] (Scheme 1), and pyridotriazoles[8f] as coupling partners. The use of internal alkyne as coupling partner is very common with Rh(III) catalyst system but terminal alkynes are scant.[9] It is believed that terminal alkynes are less compatible with Rh(III) catalyst because of acidic terminal proton leading to homocoupling under oxidative conditions. This creates a hurdle for the applicability of directing group strategy in synthesizing many important structural moieties. To solve this pitfall, recently Li, Glorius, Loh, and Chang have independently reported Rh(III) catalyzed C−H functionalization for the direct construction of versatile disubstituted alkynes by using prefunctionalized hypervalent iodine-alkynes as powerful alkynylating reagents.[10] Very recently, we have shown an approach using arylalkynyl silanes as an alternate to terminal alkynes for the *ortho*-alkenylation of secondary benzamides using Co(III)-catalyst.[11] In continuation of our efforts on C−H activation studies,[12] herein we report the synthesis of 1,2-benzothiazines that are substituent-free at the C-4 position using sulfoximine as a directing group and trimethylsilylacetylene derivatives as a coupling partner through desilylation pathway using the Rh(III) catalytic system (Scheme 1).

We initiated the optimization studies by checking the compatibility of terminal alkynes. Therefore, we performed the reaction of sulfoximine **1a** (0.2 mmol) with phenyl acetylene (0.24 mmol) using $[RhCp^*Cl_2]_2$ (5 mol %), $AgSbF_6$ (20 mol %), and $Cu(OAc)_2{\cdot}H_2O$ (20 mol %) in DCE (2 mL) in an oxygen atmosphere for 4 h (entry 1, Table 1). This reaction failed to give the desired product, indicating the non-compatibility of terminal alkynes for this reaction. Inspired by our previous work,[10] we performed the same reaction with arylalkynyl silane **2a** instead of phenyl acetylene, which afforded the corresponding annulated products **3aa** and **3aa′** in 49 and 7% yields, respectively (entry 2). Solvent screening revealed that toluene is the best solvent for this reaction (entries 3−5). Performing the reaction with different cationic species of rhodium catalyst and the acetate complex of rhodium species did not bring any significant improvement to the outcome of the reaction (entries 6 and 7). Changing the silver salts from $AgSbF_6$ to $AgBF_4$ or $AgNTf_2$ was not helpful (entries 8 and 9). Performing the reaction with $Fe(OAc)_2$ or AgOAc as an oxidant instead of $Cu(OAc)_2{\cdot}H_2O$ also was not useful in improving the yield of **3aa** (entries 10 and 11). Introduction of the additives such as NaOAc to this reaction brought an incremental improvement in the yield of **3aa** (58%, entry 12), whereas the addition of AcOH as an acid additive resulted in lowering the yield of **3aa** to 25% (entry 13). Performing the reaction of **1a** with **2a** using 10 equiv of H_2O as an additive enhanced the yield of the product **3aa** to 65% (entry 14). Increasing the $Cu(OAc)_2{\cdot}H_2O$ loading or Rh catalyst loading did not improve the yield of **3aa** (entries 15 and 16). Decreasing or increasing the reaction temperatures was not useful in improving the yield of **3aa** (entries 17 and 18). Reactions in the absence of $AgSbF_6$ or $Cu(OAc)_2{\cdot}H_2O$ furnished the product **3aa** in lower yields (entries 19 and 20). Performing the reaction in open air instead of oxygen

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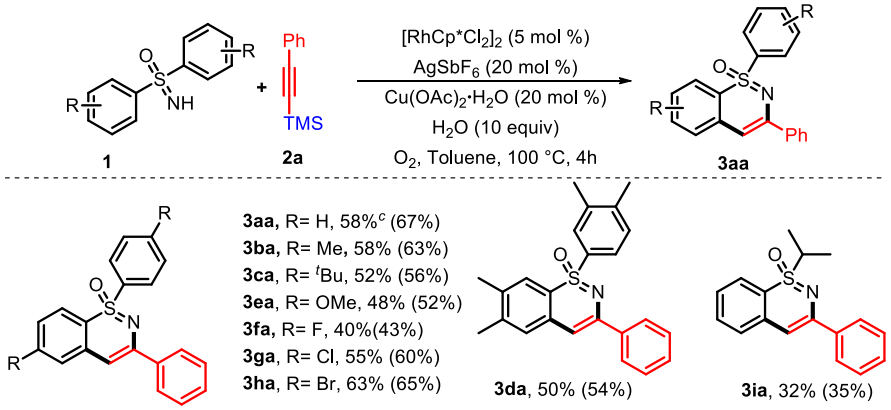
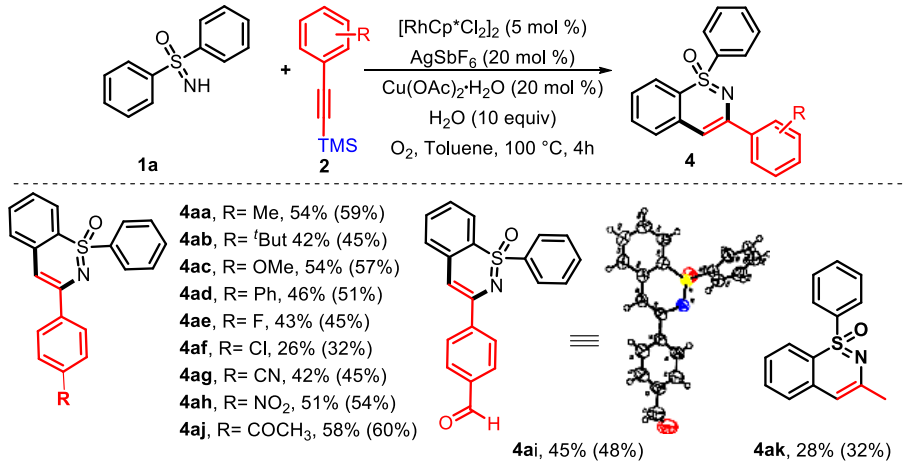
Scheme 2. Substrate Scope for Sulfoximine Derivatives[a−c]



[a]Reaction conditions: **1** (0.2 mmol), **2a** (0.24 mmol), $[Cp^*RhCl_2]_2$ (5 mol %), $AgSbF_6$ (20 mol %), $Cu(OAc)_2{\cdot}H_2O$ (20 mol %), H_2O (10 equiv), toluene (2 mL) at 100 °C for 4 h under O_2. [b]Isolated yield. NMR yields are in parentheses. [c]2 mmol scale.

Scheme 3. Substrate Scope for Arylalkynyl Silane Derivatives[a−c]



[a]Reaction conditions: **1a** (0.2 mmol), **2** (0.24 mmol), $[Cp^*RhCl_2]_2$ (5 mol %), $AgSbF_6$ (20 mol %), $Cu(OAc)_2{\cdot}H_2O$ (20 mol %), H_2O (10 equiv), toluene (2 mL) at 100 °C for 4 h under O_2. [b]Isolated yield. NMR yields are in the parentheses. [c]2 mmol scale.

atmosphere decreased the yield of **3aa** to 39%, indicating that oxygen is necessary for this transformation (entry 21). It is noteworthy to mention that the optimal yield of this reaction (entry 14) is moderate; other modifications resulted either in no reaction or reduced yield of **3aa** due to the degradation of the sulfoximine **1a** under the reaction conditions. Therefore, further studies were continued using the conditions mentioned in entry 14 for exploring the scope of the reaction.

Having optimal conditions in hand (entry 14, Table 1), we explored the scope of the reaction with various sulfoximine derivatives (Scheme 2). Thus, methyl and *tert*-butyl substitution on the various positions of the aryl ring of sulfoximine reacted with **2a** under the optimal conditions, affording the products **3ba**−**3da** in 50−58% yields. Electron-donating group such as methoxy at the *para*-position of the aryl ring furnished the product **3ea** in 48% yield. Halogenated aryl sulfoximine underwent a smooth reaction with **2a** forming the corresponding annulated products **3fa**−**3ha** in 40−63% yields. Unsymmetrical sulfoximine such as isopropyl aryl sulfoximine reacted with **2a** and rendered the corresponding product **3ia** in only 32% yield. A scale-up experiment of sulfoximine **1a** (2 mmol, 434 mg) with **2a** under optimal reaction conditions afforded the corresponding product **3aa** in 58% yield.[13]

Next, we explored the scope of the arylalkynyl silane derivatives (Scheme 3). Thus, methyl, *tert*-butyl, methoxy, and phenyl groups on the *para*-position of arylalkynyl silanes reacted with **1a** and afforded the products **4aa**−**4ad** in 42−54% yields. 4-Fluoro arylalkynyl silane reacted with **1a** under the optimal conditions, furnishing the annulated product **4ae** in 43% yield, whereas 4-chloro arylalkynyl silane provided the corresponding annulated product **4af** in only 26% yield. Electron-withdrawing groups such as cyano, nitro, and carbonyl groups on *para*-position of **2** displayed a good reactivity with **1a** and delivered the products **4ag**−**4ai** in 42−58% yields. Similarly, when arylalkynyl silane such as trimethyl(prop-1-yn-1-yl)silane was treated with **1a** under optimal conditions, the corresponding annulated product **4ak** was delivered in only 28% yield.[13]

To gain insight into the reaction mechanism, a few control experiments were performed. Thus, sulfoximine **1a** was reacted with 10 equiv of D_2O under the optimal reaction conditions, which led to 80% deuterium incorporation at the *ortho*-carbons of the sulfoximine (Scheme 4, eq 1). This experiment indicates that C−H activation might be a reversible process. The reaction of **1a**, **1a**-d_2, and **2a** under optimal conditions furnished a mixture of products **3aa** and **deuterio-3aa** in 52%

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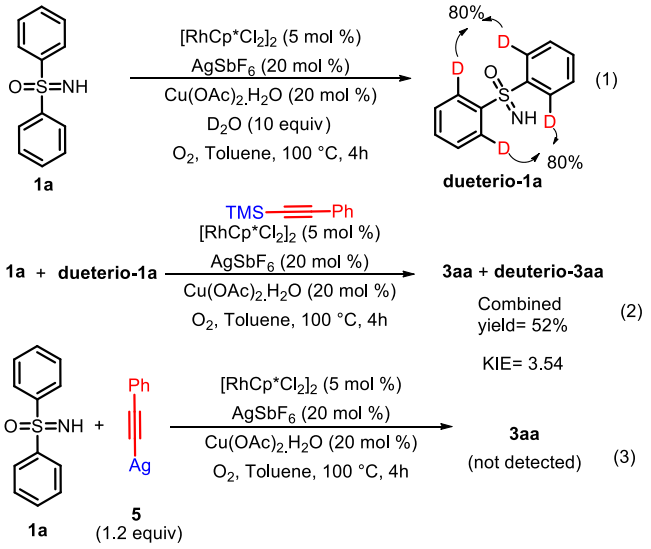
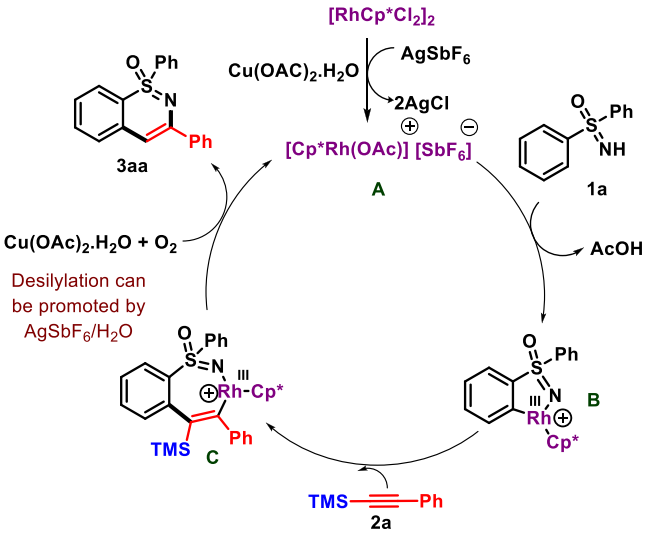
Scheme 4. Control Experiments



yield with KIE value of 3.54, indicating that the C−H activation step may be a rate-determining step (eq 2). We hypothesized that arylalkynyl silane **2a** could form silver phenylacetylide **5** in the presence of $AgSbF_6$. Therefore, we performed a reaction of **1a** with silver phenylacetylide **5**, which failed to afford the product **3aa**, indicating that silver phenylacetylide **5** may not be an intermediate in this reaction.

On the basis of the control experiments, literature precedence,[8] and our previous work on desilylation,[10] a plausible reaction mechanism is proposed in Scheme 5.

Scheme 5. Proposed Mechanism



Initially, $[RhCp^*Cl_2]_2$ reacts with $AgSbF_6$ and $Cu(OAc)_2 \cdot H_2O$, forming an active catalyst **A**. Further, the active catalyst **A** reacts with **1a**, forming the rhodacycle **B** through a concerted metalation and deprotonation pathway, followed by the insertion of arylalkynyl silane **2a** to form the 7-membered intermediate **C**. The intermediate **C** under goes a reductive elimination, affording the product **3aa** along with Rh^ICp^*. The active catalyst **A** was regenerated by the reoxidation of copper salt and oxygen. As described in our earlier work,[10] the desilylation of intermediate **C** can be promoted by the SbF_6^- and H_2O, which is present in the medium.

In conclusion, we developed a method for synthesizing 1,2-benzothiazine derivatives using Rh(III) catalyst under oxidative conditions. In this report, we utilized arylalkynyl silane as an alternate for terminal alkylation via the desilylation pathway. Interestingly, the obtained 1,2-benzothiazine derivatives have the substituent free at the C-4 position, which can be further functionalized at that position. Degradation of the sulfoximine under the reaction conditions could be the reason for obtaining moderate yields of 1,2-benzothiazine derivatives.

EXPERIMENTAL SECTION

General Information. All reactions were carried out using distilled solvents. Reactions were monitored by using precoated silica TLC plates. Mass spectra were recorded on EI and ESI (TOF) modes. NMR spectra were recorded at 400 MHz spectrometers in $CDCl_3$ or DMSO-d_6; tetramethylsilane (TMS; δ = 0.00 ppm) served as an internal standard for ^{1}H NMR. The corresponding residual nondeuterated solvent signal ($CDCl_3$; δ = 77.16 ppm and DMSO-d_6; δ = 39.52 ppm) was used as an internal standard for ^{13}C NMR. Column chromatography was carried out on silica gel 230−400 mesh or 100−200 mesh (Merck), and thin-layer chromatography was carried out using silica gel GF-254. Chemicals obtained from commercial suppliers were used without further purification. All sulfoximine derivatives,[14] arylalkynyl silane derivatives,[15] and silver phenylacetylide[16] were synthesized according to reported literature procedure.

Experimental Procedures and Data. *A. General Experimental Procedure to Prepare Sulfoximines.* In a 50 mL round bottomed flask with a magnetic bar was suspended sulfoxide derivative (4.0 mmol) in methanol (25 mL). (Diacetoxyiodo)benzene (10.0 mmol) and ammonium acetate (8 mmol) were added and stirred for 12 h at room temperature. After completion of the reaction (monitored by TLC), solvent was removed by distillation under reduced pressure. The crude products were purified by flash column chromatography using ethyl acetate and petroleum ether mixture.

B. General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives. In an 8 mL screw cap reaction vial, sulfoximine derivatives (0.2 mmol), arylalkynyl silane derivative (0.24 mmol), $Cu(OAc)_2 \cdot H_2O$ (8 mg, 20 mol %), rhodium catalyst (6.2 mg, 5 mol %), and $AgSbF_6$ (13.8 mg, 20 mol %) were added followed by the addition of toluene (2 mL) and water (36 mg, 2.0 mmol). This vial was sealed with a screw cap after flushing with oxygen and placed in a preheated metal block at 100 °C, and the reaction mixture was stirred at the same temperature for 5 h. After completion of the reaction (monitored by TLC), the reaction mixture was cooled to room temperature and filtered through silica gel bed (100−200 mesh), and the resulting filtrate was concentrated under reduced pressure. The crude products were purified by flash column chromatography using an ethyl acetate and petroleum ether mixture.

C. Experimental Procedure for Scale-Up Reaction. In a 50 mL pressure tube, diphenylsulfoximine (2.29 mmol, 500 mg), 1-phenyl-2-trimethylsilylacetylene (2.74 mmol, 477 mg), $Cu(OAc)_2 \cdot H_2O$ (91 mg, 20 mol %), rhodium catalyst (70.7 mg, 5 mol %), and $AgSbF_6$ (157.6 mg, 20 mol %) were added followed by the addition of toluene (25 mL) and water (360 mg, 20 mmol). This tube was sealed with a screw cap after flushing with oxygen and placed in a preheated oil bath at 100 °C, and the reaction mixture was stirred at the same temperature for 5 h. After completion of the reaction (monitored by TLC), the reaction mixture was cooled to room temperature and filtered through silica gel bed (100−200 mesh), and the resulting filtrate was concentrated under reduced pressure. The crude products were purified on a column using ethyl acetate and petroleum ether mixture.

*Sulfonimidoyldibenzene (**1a**).* Prepared as shown in General Experimental Procedure to Prepare Sulfoximines (A). Purified by flash chromatography on 100−200 mesh silica gel using EtOAc:petroleum

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ether (20:80 v/v) as eluent to obtain a white solid. Isolated yield: 82% (0.71g); mp: 102−104 °C (lit.[8a] −102.5−104.4 °C); IR (Neat, cm^{-1}): 3275, 3059, 2920, 1445, 1227, 1129, 1061; ^1H NMR ($CDCl_3$, 400 MHz): δ 8.08−8.02 (m, 4H), 7.56−7.43 (m, 6H), 2.95 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 143.4, 132.6, 129.2, 128.0; HRMS (ESI) (m/z): Calcd for $C_{12}H_{11}NOSH$ $[M + H]^+$: 218.0640, found $[M + H]^+$: 218.0639.

*4,4′-Sulfonimidoylbis(methylbenzene) (**1b**).* Prepared as shown in General Experimental Procedure to Prepare Sulfoximines (A). Purified by flash chromatography on 100−200 mesh silica gel using EtOAc:petroleum ether (20:80 v/v) as eluent to obtain a pale brown solid. Isolated yield: 76% (0.74 g); mp: 101−103 °C; IR (Neat, cm^{-1}): 3274, 3059, 1595, 1491, 1240, 1136, 1094; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.90 (d, J = 8.2 Hz, 4H), 7.25 (d, J = 8.1 Hz, 4H), 2.79 (s, 1H), 2.37 (s, 6H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 143.3, 140.8, 129.8, 127.9, 21.5; HRMS (ESI) (m/z): Calcd for $C_{14}H_{15}NOSH$ $[M + H]^+$: 246.0953, found $[M + H]^+$: 246.0952.

*4,4′-Sulfonimidoylbis(tert-butylbenzene) (**1c**).* Prepared as shown in General Experimental Procedure to Prepare Sulfoximines (A). Purified by flash chromatography on 100−200 mesh silica gel using EtOAc:petroleum ether (10:90 v/v) as eluent to obtain a white solid. Isolated yield: 63% (0.82 g); mp: 111−113 °C (charred) ; IR (Neat, cm^{-1}): 3303, 2959, 2853, 1587, 1467, 1231, 1136, 1084; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.95 (d, J = 8.6 Hz, 4H), 7.48 (d, J = 8.6 Hz, 4H), 1.30 (s, 18H), 1.25 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 156.4, 140.5, 127.9, 126.3, 35.2, 31.2; HRMS (ESI) (m/z): Calcd for $C_{20}H_{27}NOSH$ $[M + H]^+$: 330.1892, found $[M + H]^+$: 330.1893.

*4,4′-Sulfonimidoylbis(1,2-dimethylbenzene) (**1d**).* Prepared as shown in General Experimental Procedure to Prepare Sulfoximines (A). Purified by flash chromatography on 100−200 mesh silica gel using EtOAc:petroleum ether (20:80 v/v) as eluent to obtain a white solid. Isolated yield: 49% (0.53 g); mp: 121−123 °C; IR (Neat, cm^{-1}): 3272, 3050, 1449, 1226, 1113, 1088; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.79−7.72 (m, 4H), 7.21 (d, J = 7.9 Hz, 2H), 2.59 (s, 1H), 2.28 (s, 6H), 2.27 (s, 6H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 142.0, 141.0, 137.9, 130.3, 128.7, 125.4, 20.0, 19.9; HRMS (ESI) (m/z): Calcd for $C_{16}H_{19}NOSNa$ $[M + Na]^+$: 296.1085, found $[M + Na]^+$: 296.1086.

*4,4′-Sulfonimidoylbis(methoxybenzene) (**1e**).* Prepared as shown in General Experimental Procedure to Prepare Sulfoximines (A). Purified by flash chromatography on 100−200 mesh silica gel using EtOAc:petroleum ether (30:70 v/v) as eluent to a pale brown solid. Isolated yield: 75% (0.83 g); mp: 137−139 °C (lit.[8a] −137.5−138.2 °C); IR (Neat, cm^{-1}): 3326, 3064, 2947, 1593, 1495, 1257, 1132, 1097; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.94 (d, J = 9.0 Hz, 4H), 6.92 (d, J = 8.9 Hz, 4H), 3.82 (s, 6H), 2.79 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 162.8, 135.6, 129.8, 114.4, 55.7; HRMS (ESI) (m/z): Calcd for $C_{14}H_{15}NO_3SNa$ $[M + Na]^+$: 300.0670, found $[M + Na]^+$: 300.0667

*4,4′-Sulfonimidoylbis(fluorobenzene) (**1f**).* Prepared as shown in General Experimental Procedure to Prepare Sulfoximines (A). Purified by flash chromatography on 100−200 mesh silica gel using EtOAc:petroleum ether (10:90 v/v) as eluent to obtain a colorless liquid. Isolated yield: 60% (0.6 g); IR (Neat, cm^{-1}): 3275, 3103, 3067, 1589, 1489, 1244, 1130, 1094; ^1H NMR ($CDCl_3$, 400 MHz): δ 8.04 (dd, J = 7.9, 5.6 Hz, 4H), 7.16 (t, J = 8.4 Hz, 4H), 2.82 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 165.33 (d, J_{C-F} = 255.37 Hz), 139.4, 130.7 (d, J = 9.5 Hz), 116.5 (d, J = 22.5 Hz); HRMS (ESI) (m/z): Calcd for $C_{12}H_9F_2NOSH$ $[M + H]^+$: 254.0451, found $[M + H]^+$: 254.0451

*4,4′-Sulfonimidoylbis(Chlorobenzene) (**1g**).* Prepared as shown in General Experimental Procedure to Prepare Sulfoximines (A). Purified by flash chromatography on 100−200 mesh silica gel using EtOAc:petroleum ether (15:85 v/v) as eluent to obtain a white solid. Isolated yield: 62% (0.7 g); mp: 107−109 °C (lit.[8a] −108.7−110.1 °C); IR (Neat, cm^{-1}): 3273, 3088, 1576, 1473, 1239, 1133, 1089; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.95 (d, J = 8.5 Hz, 4H), 7.45 (d, J = 8.4 Hz, 4H), 2.94 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 141.7, 139.6, 129.6, 129.5; HRMS (ESI) (m/z): Calcd for $C_{12}H_9Cl_2NOSH$ $[M + H]^+$: 285.9860, found $[M + H]^+$: 285.9863

*4,4′-Sulfonimidoylbis(Bromorobenzene) (**1g**).* Prepared as shown in General Experimental Procedure to Prepare Sulfoximines (A). Purified by flash chromatography on 100−200 mesh silica gel using EtOAc:petroleum ether (15:85 v/v) as eluent to obtain a white solid. Isolated yield: 81% (1.25 g); mp: 138−140 °C (lit.[8a] −137.9−139 °C); IR (Neat, cm^{-1}): 3270, 3085, 1571, 1469, 1235, 1129, 1064; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.87 (d, J = 8.6 Hz, 4H), 7.62 (d, J = 8.6 Hz, 4H), 2.44 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 132.7, 129.6, 128.3; HRMS (ESI) (m/z): Calcd for $C_{12}H_9Br_2NOSH$ $[M + H]^+$: 373.8850, found $[M + H]^+$: 373.8850

*(Propan-2-ylsulfonimidoyl)benzene (**1i**).* Prepared as shown in General Experimental Procedure to Prepare Sulfoximines (A). Purified by flash chromatography on 100−200 mesh silica gel using EtOAc:petroleum ether (20:80 v/v) as eluent to obtain a colorless liquid. Isolated yield: 44% (0.32 g); IR (Neat, cm^{-1}): 3273, 3061, 2978, 1444, 1213, 1102; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.95 (d, J = 7.7 Hz, 2H), 7.62 (dd, J = 10.5, 4.2 Hz, 1H), 7.55 (dd, J = 8.1, 7.1 Hz, 2H), 3.25 (dt, J = 13.6, 6.8 Hz, 1H), 2.58 (s, 1H), 1.32 (d, J = 6.8 Hz, 3H), 1.27 (d, J = 6.8 Hz, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 139.9. 133.1, 129.4, 129.0, 56.6, 16.4, 16.1; HRMS (ESI) (m/z): Calcd for $C_9H_{13}NOSH$ $[M + H]^+$: 184.0796, found $[M + H]^+$: 184.0793.

*1,3-Diphenylbenzo[e][1,2]thiazine 1-oxide (**3aa**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (3:97 v/v) as eluent to obtain a yellow solid. Isolated yield: 62% (39 mg); mp: 129−131 °C; R_f (25% EtOAc-Pet. ether) = 0.6; IR (Neat, cm^{-1}): 3060, 3024, 1582, 1219, 1112; ^1H NMR ($CDCl_3$, 400 MHz): δ 8.06−7.93 (m, 4H), 7.67−7.60 (m, 1H), 7.57 (t, J = 7.4 Hz, 2H), 7.51−7.45 (m, 1H), 7.45−7.38 (m, 3H), 7.34 (dd, J = 14.1, 7.5 Hz, 2H), 7.24−7.19 (m, 1H), 6.81 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 147.3, 140.6, 138.9, 136.62, 133.5, 132.2, 129.4, 129.1, 128.9, 128.5, 127.0, 126.7, 126.4, 125.0, 119.7, 98.3; HRMS (ESI) (m/z): Calcd for $C_{20}H_{15}NOSH$ $[M + H]^+$:318.0953, found $[M + H]^+$: 318.0952.

*(Z)-3-Benzylidene-1-phenylbenzo[d]isothiazole 1-oxide (**3aa′**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (3:97 v/v) as eluent to obtain a yellow solid. Isolated yield: 6% (3.8 mg); mp: 144−146 °C; R_f (25% EtOAc-Pet. ether) = 0.5; IR (Neat, cm^{-1}): 3059, 3018,1591,1219; ^1H NMR ($CDCl_3$, 400 MHz): δ 8.16 (d, J = 7.4 Hz, 2H), 7.92 (dd, J = 7.4, 1.4 Hz, 3H), 7.68−7.57 (m, 3H), 7.52 (t, J = 7.7 Hz, 2H), 7.39 (dt, J = 13.9, 7.8 Hz, 3H), 7.21 (t, J = 7.4 Hz, 1H), 6.54 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 13C NMR (101 MHz, CDCl3) δ 143.60 (s), 141.1, 138.7, 136.8, 135.4, 133.8, 132.8, 129.6, 129.5, 128.9, 128.4, 126.5, 122.5, 121.6, 108.1; HRMS (ESI) (m/z): Calcd for $C_{20}H_{15}NOSH$ $[M + H]^+$:318.0953, found $[M + H]^+$: 318.0952.

*6-Methyl-3-phenyl-1-(p-tolyl)benzo[e][1,2]thiazine 1-oxide (**3ba**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (4:96 v/v) as eluent to obtain a yellow solid. Isolated yield: 58% (40 mg); mp: 134−136 °C; R_f (25% EtOAc-Pet. ether) = 0.6; IR (Neat, cm^{-1}): 2923, 2853,1591, 1223, 1107; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.99 (d, J = 7.6 Hz, 2H), 7.85 (d, J = 8.2 Hz, 2H), 7.40 (t, J = 7.5 Hz, 2H), 7.37−7.31 (m, 3H), 7.23 (d, J = 8.0 Hz, 2H), 7.03 (d, J = 8.6 Hz, 1H), 6.73 (s, 1H), 2.44 (s, 3H), 2.39 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 147.3, 144.4, 142.7, 139.1, 137.9, 136.7, 129.7, 129.3, 128.8, 128.4, 127.8, 126.7, 126.6, 125.0, 117.7, 98.1, 21.8, 21.7; HRMS (ESI) (m/z): Calcd for $C_{22}H_{19}NOSH$ $[M + H]^+$: 346.1266, found $[M + H]^+$: 346.1268.

*6-(tert-Butyl)-1-(4-(tert-butyl)phenyl)-3-phenylbenzo[e][1,2]-thiazine 1-oxide (**3ca**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (2:98 v/v) as eluent to obtain yellow solid. Isolated yield: 52% (44 mg); mp: 190−192 °C; R_f (20% EtOAc-Pet.

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J. Org. Chem. XXXX, XXX, XXX−XXX

ether) = 0.7; IR (Neat, cm^{-1}): 3060, 3025, 2962, 1591, 1221, 1120, 1097; ^1H NMR ($CDCl_3$, 400 MHz): δ 8.01 (d, J = 7.9 Hz, 2H), 7.90 (d, J = 8.2 Hz, 2H), 7.56 (d, J = 6.5 Hz, 2H), 7.46−7.31 (m, 4H), 7.29 (d, J = 0.5 Hz, 2H), 6.80 (s, 1H), 1.34 (d, J = 2.7 Hz, 18H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 157.2, 155.5, 147.1, 139.2, 137.8, 136.5, 129.2, 128.7, 128.4, 126.7, 126.1, 124.8, 124.6, 123.02, 117.5, 98.6, 35.3, 35.2, 31.2, 31.1; HRMS (ESI) (m/z): Calcd for $C_{28}H_{31}NOSH$ $[M + H]^+$: 430.2205, found $[M + H]^+$: 430.2204.

*1-(3,4-Dimethylphenyl)-6,7-dimethyl-3-phenylbenzo[e][1,2]-thiazine 1-oxide (**3da**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (5:95 v/v) as eluent to obtain a yellow solid. Isolated yield: 50% (44 mg); mp: 191−193 °C; R_f (30% EtOAc-Pet. ether) = 0.6; IR (Neat, cm^{-1}): 2921, 2856, 1688, 1587, 1485, 1220, 1098; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.98 (d, J = 7.4 Hz, 2H), 7.77−7.65 (m, 2H), 7.39 (t, J = 7.4 Hz, 2H), 7.32 (t, J = 8.4 Hz, 2H), 7.20 (s, 1H), 7.08 (s, 1H), 6.71 (s, 1H), 2.34 (s, 3H), 2.30 (s, 6H), 2.19 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 146.2, 143.0, 142.1, 139.2, 138.2, 137.9, 136.0, 134.7, 130.2, 130.1, 128.5, 128.4, 127.2, 126.9, 126.6, 124.8, 117.9, 97.7, 20.3, 20.1, 20.0, 19.9; HRMS (ESI) (m/z): Calcd for $C_{24}H_{23}NOSH$ $[M + H]^+$: 374.1579, found $[M + H]^+$: 374.1575.

*6-Methoxy-1-(4-methoxyphenyl)-3-phenylbenzo[e][1,2]thiazine 1-oxide (**3ea**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (10:90 v/v) as eluent to obtain a yellow solid. Isolated yield: 48% (37 mg); mp: 172−174 °C; R_f (30% EtOAc-Pet. ether) = 0.5; IR (Neat, cm^{-1}): 2924, 2846, 1589, 1465, 1259, 1107, 1024; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.99 (d, J = 7.4 Hz, 2H), 7.87 (d, J = 8.8 Hz, 2H), 7.37 (dt, J = 22.0, 7.0 Hz, 3H), 7.28−7.23 (m, 1H), 7.00 (d, J = 8.8 Hz, 2H), 6.79 (d, J = 2.8 Hz, 2H), 6.71 (s, 1H), 3.86 (s, 6H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 163.5, 162.1, 147.9, 139.0, 138.8, 132.7, 131.3, 128.8, 128.4, 127.0, 126.8, 115.9, 114.3, 113.4, 107.5, 98.1, 55.8, 55.6; HRMS (ESI) (m/z): Calcd for $C_{22}H_{19}NO_3SH$ $[M + H]^+$: 378.1164, found $[M + H]^+$: 378.1167.

*6-Fluoro-1-(4-fluorophenyl)-3-phenylbenzo[e][1,2]thiazine 1-oxide (**3fa**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (3:97 v/v) as eluent to obtain a yellow solid. Isolated yield: 40% (29 mg); mp: 148−150 °C; R_f (20% EtOAc-Pet. ether) = 0.7; IR (Neat, cm^{-1}): 3096, 3064, 3030, 1584, 1228, 1108; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.98 (dt, J = 4.8, 2.1 Hz, 4H), 7.47−7.37 (m, 3H), 7.34 (dd, J = 8.9, 5.4 Hz, 1H), 7.25 (t, J = 8.5 Hz, 2H), 7.08 (dd, J = 9.8, 2.4 Hz, 1H), 6.95 (td, J = 8.5, 2.5 Hz, 1H), 6.75 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 165.9 (d, J_{C-F} = 256.8 Hz), 164.6 (d, J_{C-F} = 253.3 Hz), 148.6, 139.4 (d, J_{C-F} = 10.0 Hz), 138.3, 136.7 (d, J_{C-F} = 2.8 Hz), 132.0 (d, J_{C-F} = 9.7 Hz), 129.3, 128.5, 128.1 (d, J_{C-F} = 10.2 Hz), 126.8, 116.5 (d, J_{C-F} = 22.8 Hz), 115.9, 115.1(d, J_{C-F} = 24.6 Hz), 111.8 (d, J_{C-F} = 22.22 Hz), 97.9 (d, J_{C-F} = 2.6 Hz); ^{19}F NMR ($CDCl_3$, 377 MHz): δ −104.0, −105.6; HRMS (ESI) (m/z): Calcd for $C_{20}H_{13}F_2NOSH$ $[M + H]^+$: 354.0764, found $[M + H]^+$: 354.0762.

*6-Chloro-1-(4-chlorophenyl)-3-phenylbenzo[e][1,2]thiazine 1-oxide (**3ga**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (3:97 v/v) as eluent to obtain a yellow solid. Isolated yield: 55% (45 mg); mp: 146−148 °C; R_f (20% EtOAc-Pet. ether) = 0.7; IR (Neat, cm^{-1}): 3087, 3061, 3022, 1575, 1220, 1087; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.97 (d, J = 6.9 Hz, 2H), 7.88 (d, J = 8.4 Hz, 2H), 7.54 (d, J = 8.4 Hz, 2H), 7.47−7.33 (m, 4H), 7.24 (d, J = 8.3 Hz, 1H), 7.17 (d, J = 8.5 Hz, 1H), 6.73 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 148.7, 140.7, 138.8, 138.7, 138.2, 138.2, 130.7, 129.5, 129.4, 128.6, 126.8, 126.8, 126.6, 126.2, 117.4, 97.6; HRMS (ESI) (m/z): Calcd for $C_{20}H_{13}Cl_2NOSH$ $[M + H]^+$: 386.0173, found $[M + H]^+$: 386.0172.

*6-Bromo-1-(4-bromophenyl)-3-phenylbenzo[e][1,2]thiazine 1-oxide (**3ha**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (2:98 v/v) as eluent to obtain a yellow solid. Isolated yield: 63% (60 mg); mp: 159−161 °C; R_f (20% EtOAc-Pet. ether) = 0.8; IR (Neat, cm^{-1}): 3080, 3024, 1569, 1224, 1069; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.96 (d, J = 7.0 Hz, 2H), 7.80 (d, J = 8.5 Hz, 2H), 7.70 (d, J = 8.5 Hz, 2H), 7.60 (s, 1H), 7.47−7.36 (m, 3H), 7.32 (dd, J = 8.5, 1.3 Hz, 1H), 7.16 (d, J = 8.5 Hz, 1H), 6.72 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 148.7, 140.7, 139.0, 138.7, 138.2, 138.2, 130.7, 129.5, 129.4, 128.6, 126.8, 126.8, 126.6, 126.2, 117.4, 97.6; HRMS (ESI) (m/z): Calcd for $C_{20}H_{13}Br_2NOSH$ $[M + H]^+$: 473.9163, found $[M + H]^+$: 473.9167.

*1-Isopropyl-3-phenylbenzo[e][1,2]thiazine 1-oxide (**3ia**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (4:96 v/v) as eluent to obtain a yellow semisolid. Isolated yield: 32% (19 mg); R_f (30% EtOAc-Pet. ether) = 0.7; IR (Neat, cm^{-1}): 3058, 2976, 2930, 1583, 1207, 1105; ^1H NMR ($CDCl_3$, 400 MHz): δ 8.01−7.94 (m, 2H), 7.73 (d, J = 8.0 Hz, 1H), 7.56−7.50 (m, 1H), 7.43−7.39 (m, 2H), 7.38−7.30 (m, 3H), 6.54 (s, 1H), 3.84 (hept, J = 6.8 Hz, 1H), 1.57 (d, J = 6.9 Hz, 3H), 1.19 (d, J = 6.7 Hz, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 148.1, 138.9, 138.8, 132.9, 128.9, 128.4, 127.1, 126.5, 126.1, 124.5, 114.8, 97.2, 58.0, 17.5, 13.7; HRMS (ESI) (m/z): Calcd for $C_{17}H_{17}NOSH$ $[M + H]^+$: 284.1109, found $[M + H]^+$: 284.1109.

*Phenyl-3-(p-tolyl)benzo[e][1,2]thiazine 1-oxide (**4aa**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (5:95 v/v) as eluent to obtain a yellow solid. Isolated yield: 54% (36 mg); mp: 193−195 °C; R_f (30% EtOAc-Pet. ether) = 0.6; IR (Neat, cm^{-1}): 3061, 3020, 2922, 2854, 1583, 1219, 1111; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.99 (d, J = 5.6 Hz, 2H), 7.90 (d, J = 6.1 Hz, 2H), 7.58 (dd, J = 18.8, 5.5 Hz, 3H), 7.51−7.36 (m, 2H), 7.31 (d, J = 6.9 Hz, 1H), 7.21 (d, J = 5.0 Hz, 3H), 6.78 (s, 1H), 2.37 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 147.3, 140.6, 138.9, 136.7, 136.1, 133.4, 132.2, 129.4, 129.2, 129.1, 126.9, 126.6, 126.1, 125.0, 119.5, 97.7, 21.4; HRMS (ESI) (m/z): Calcd for $C_{21}H_{17}NOSNa$ $[M + Na]^+$: 354.0929, found $[M + Na]^+$: 354.0925.

*3-(4-(tert-Butyl)phenyl)-1-phenylbenzo[e][1,2]thiazine 1-oxide (**4ab**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (1:99 v/v) as eluent to obtain a yellow solid. Isolated yield: 42% (32 mg); mp: 177−179 °C; R_f (10% EtOAc-Pet. ether) = 0.8; IR (Neat, cm^{-1}): 3061, 2959, 2926, 2858, 185, 1222, 1113; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.99 (d, J = 7.3 Hz, 2H), 7.94 (d, J = 8.2 Hz, 2H), 7.61 (d, J = 6.9 Hz, 1H), 7.57 (d, J = 7.5 Hz, 2H), 7.43 (t, J = 7.1 Hz, 4H), 7.32 (d, J = 7.8 Hz, 1H), 7.20 (t, J = 7.1 Hz, 1H), 6.78 (s, 1H), 1.34 (s, 9H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 152.1, 147.4, 140.8, 136.8, 136.1, 133.4, 132.2, 129.4, 129.1, 126.9, 126.5, 126.2, 125.4, 125.1, 119.6, 97.7, 34.8, 31.4; HRMS (ESI) (m/z): Calcd for $C_{24}H_{23}NOSH$ $[M + H]^+$: 374.1579, found $[M + H]^+$: 374.1577.

*3-(4-Methoxyphenyl)-1-phenylbenzo[e][1,2]thiazine 1-oxide (**4ac**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (5:95 v/v) as eluent to obtain yellow solid. Isolated yield: 54% (35 mg); mp: 166−168 °C; R_f (30% EtOAc-Pet. ether) = 0.6; IR (Neat, cm^{-1}): 3063, 2932, 2837, 1593, 1251, 1218, 1110; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.97 (dd, J = 15.4, 8.1 Hz, 4H), 7.63 (t, J = 7.3 Hz, 1H), 7.57 (t, J = 7.5 Hz, 2H), 7.46 (t, J = 7.8 Hz, 1H), 7.40 (d, J = 7.7 Hz, 1H), 7.31 (d, J = 7.9 Hz, 1H), 7.19 (t, J = 7.5 Hz, 1H), 6.94 (d, J = 8.8 Hz, 2H), 6.72 (s, 1H), 3.84 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 160.5, 140.8, 136.9, 133.4, 132.2, 131.6, 129.4, 129.1, 128.1, 126.8, 125.9, 125.1, 119.4, 113.8, 97.0, 55.5; HRMS

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J. Org. Chem. XXXX, XXX, XXX−XXX

(ESI) (m/z): Calcd for $C_{21}H_{17}NO_2SH$ $[M + H]^+$: 348.1058, found $[M + H]^+$: 348.1059.

*3-([1,1′-Biphenyl]-4-yl)-1-phenylbenzo[e][1,2]thiazine 1-oxide (**4ad**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (10:90 v/v) as eluent to obtain a yellow solid. Isolated yield: 46% (36 mg); mp:175−177 °C; R_f (30% EtOAc-Pet. ether) = 0.6; IR (Neat, cm^{-1}): 3060, 3028, 2923, 2852, 1582, 1219, 1112; ^1H NMR ($CDCl_3$, 400 MHz): δ 8.09 (d, J = 8.0 Hz, 2H), 8.01 (d, J = 7.4 Hz, 2H), 7.72−7.61 (m, 5H), 7.60−7.53 (m, 2H), 7.52−7.40 (m, 4H), 7.39−7.29 (m, 2H), 7.29−7.17 (m, 1H), 6.86 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 146.9, 141.6, 140.8, 140.6, 137.8, 136.6, 133.5, 132.2, 129.5, 129.1, 128.9, 127.5, 127.2, 127.2, 127.0, 126.4, 125.1, 119.8, 98.3; HRMS (ESI) (m/z): Calcd for $C_{26}H_{19}NOSH$ $[M + H]^+$: 394.1266, found $[M + H]^+$: 394.1265.

*3-(4-Fluorophenyl)-1-phenylbenzo[e][1,2]thiazine 1-oxide (**4ae**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (3:97 v/v) as eluent to obtain a yellow solid. Isolated yield: 43% (28 mg); mp: 135−137 °C; R_f (20% EtOAc-Pet. ether) = 0.7; IR (Neat, cm^{-1}): 3065, 2924, 2851, 1588, 1341, 1221, 1112; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.99 (t, J = 7.3 Hz, 4H), 7.66 (t, J = 7.3 Hz, 1H), 7.59 (t, J = 7.5 Hz, 2H), 7.50 (t, J = 7.6 Hz, 1H), 7.43 (d, J = 7.9 Hz, 1H), 7.32 (d, J = 8.0 Hz, 1H), 7.22 (d, J = 7.3 Hz, 1H), 7.09 (t, J = 8.7 Hz, 2H), 6.75 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 163.4 (J_{C-F} = 248.39 Hz), 146.3, 140.5, 136.6, 133.6, 132.3, 129.5, 129.1, 128.6, 128.5, 127.0, 126.5, 125.1, 119.7, 115.5, 115.2, 98.0; ^{19}F NMR ($CDCl_3$, 377 MHz): δ 113.15; ^{19}F NMR ($CDCl_3$, 377 MHz): δ −103.98, −105.59; HRMS (ESI) (m/z): Calcd for $C_{20}H_{14}FNOSH$ $[M + H]^+$: 336.0858, found $[M + H]^+$: 336.0855.

*3-(4-Chlorophenyl)-1-phenylbenzo[e][1,2]thiazine 1-oxide (**4af**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (3:97 v/v) as eluent to obtain yellow a solid. Isolated yield: 26% (18 mg); mp:172−174 °C; R_f (20% EtOAc-Pet. ether) = 0.7; IR (Neat, cm^{-1}): 3060, 2961, 2867, 1584, 1220, 1113; ^1H NMR ($CDCl_3$, 400 MHz): δ 7.99 (d, J = 7.5 Hz, 2H), 7.94 (d, J = 8.5 Hz, 2H), 7.65 (t, J = 7.3 Hz, 1H), 7.59 (t, J = 7.5 Hz, 2H), 7.50 (t, J = 7.4 Hz, 1H), 7.44 (d, J = 7.9 Hz, 1H), 7.37 (d, J = 8.5 Hz, 2H), 7.32 (d, J = 8.0 Hz, 1H), 7.28−7.20 (m, 1H), 6.79 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 146.0, 140.3, 137.4, 136.4, 134.8, 133.6, 132.3, 129.5, 129.2, 128.6, 128.0, 127.1, 126.7, 125.1, 119.9, 98.4; HRMS (ESI) (m/z): Calcd for $C_{20}H_{14}ClNOSH$ $[M + H]^+$: 352.0563, found $[M + H]^+$: 352.0563.

*4-(1-Oxido-1-phenylbenzo[e][1,2]thiazin-3-yl)benzonitrile (**4ag**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (5:95 v/v) as eluent to obtain a yellow solid. Isolated yield: 42% (28 mg); mp: 154−156 °C; R_f (30% EtOAc-Pet. ether) = 0.6; IR (Neat, cm^{-1}): 3063, 2922, 2225, 1590, 1471, 1220, 1112; ^1H NMR ($CDCl_3$, 400 MHz): δ 8.11 (d, J = 8.4 Hz, 2H), 8.00 (d, J = 7.9 Hz, 2H), 7.75−7.65 (m, 3H), 7.61 (dd, J = 7.9, 7.2 Hz, 2H), 7.57−7.51 (m, 1H), 7.48 (d, J = 8.0 Hz, 1H), 7.40−7.28 (m, 2H), 6.89 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 144.9, 143.2, 140.0, 135.8, 133.8, 132.5, 132.3, 129.5, 129.3, 127.5, 127.4, 127.1, 125.1, 120.4, 112.0, 100.3; HRMS (ESI) (m/z): Calcd for $C_{21}H_{14}N_2OSNa$ $[M + Na]^+$: 365.0725, found $[M + Na]^+$: 365.0725.

*3-(4-Nitrophenyl)-1-phenylbenzo[e][1,2]thiazine 1-oxide (**4ah**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (15:85 v/v) as eluent to obtain a yellow solid. Isolated yield: 51% (51 mg); mp: 232−234 °C; R_f (30% EtOAc-Pet. ether) = 0.6; IR (Neat, cm^{-1}): 3066, 292, 2851, 1588, 1515, 1341, 1221, 1112; ^1H NMR ($CDCl_3$, 400 MHz): δ 8.26 (d, J = 7.2 Hz, 2H), 8.17 (d, J = 7.0 Hz, 2H), 8.01 (d, J = 6.4 Hz, 2H), 7.66 (dd, J = 23.3, 6.1 Hz, 3H), 7.59−7.45 (m, 2H), 7.34 (s, 2H), 6.95 (s, 1H).; $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 147.8, 145.0, 144.5, 139.8, 135.7, 133.9, 132.6, 129.5, 129.3, 127.7, 127.5, 127.3, 125.1, 123.8, 120.5, 100.9; HRMS (ESI) (m/z): Calcd for $C_{20}H_{14}N_2O_3SNa$ $[M + Na]^+$: 385.0623, found $[M + H]^+$: 385.0625.

*4-(1-Oxido-1-phenylbenzo[e][1,2]thiazin-3-yl)benzaldehyde (**4ai**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (12:88 v/v) as eluent to obtain a yellow solid. Isolated yield: 45% (32 mg); mp: 184−186 °C; R_f (30% EtOAc-Pet. ether) = 0.4; IR (Neat, cm^{-1}): 3062, 2923, 2851, 2727, 1689, 1590, 1228, 1163, 1092; ^1H NMR ($CDCl_3$, 400 MHz): δ 10.03 (s, 1H), 8.18 (d, J = 8.1 Hz, 2H), 8.01 (d, J = 7.6 Hz, 2H), 7.91 (d, J = 8.1 Hz, 2H), 7.71−7.64 (m, 1H), 7.60 (t, J = 7.5 Hz, 2H), 7.56−7.46 (m, 2H), 7.35 (d, J = 7.9 Hz, 1H), 7.30 (d, J = 7.3 Hz, 1H), 6.94 (s, 1H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 192.8, 145.5, 144.6, 140.1, 136.3, 135.9, 133.7, 132.4, 129.9, 129.5, 129.2, 127.4, 127.3, 127.1, 125.1, 120.4, 100.4; HRMS (ESI) (m/z): Calcd for $C_{21}H_{15}NO_2SH$ $[M + H]^+$: 346.0902, found $[M + H]^+$: 346.0905.

*(4-(1-Oxido-1-phenylbenzo[e][1,2]thiazin-3-yl)phenyl)ethanone (**4aj**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (10:90 v/v) as eluent to obtain a yellow solid. Isolated yield: 58% (38 mg); mp: 167−169 °C; R_f (30% EtOAc-Pet. ether) = 0.4; IR (Neat, cm^{-1}): 3062, 3012, 2922, 1679, 1595, 1267, 1221, 1112; ^1H NMR ($CDCl_3$, 400 MHz): δ 8.10 (d, J = 8.3 Hz, 2H), 8.00 (t, J = 5.7 Hz, 4H), 7.67 (t, J = 7.2 Hz, 1H), 7.60 (t, J = 7.6 Hz, 2H), 7.56−7.43 (m, 2H), 7.34 (d, J = 7.9 Hz, 1H), 7.30−7.25 (m, 1H), 6.91 (s, 1H), 2.62 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 198.0, 145.7, 143.3, 140.1, 136.9, 136.0, 133.7, 132.4, 129.5, 129.2, 128.6, 127.3, 127.1, 126.7, 125.0, 120.2, 99.9, 26.9; HRMS (ESI) (m/z): Calcd for $C_{22}H_{17}NO_2SNa$ $[M + Na]^+$: 382.0878, found $[M + Na]^+$: 382.0880.

*3-Methyl-1-phenylbenzo[e][1,2]thiazine 1-oxide (**4ak**).* Prepared as shown in General Experimental Procedure for Synthesizing 1,2-Benzothiazine Derivatives (B). Purified by flash chromatography on 230−400 mesh silica gel using EtOAc:petroleum ether (5:95 v/v) as eluent to obtain a yellow solid. Isolated yield: 28% (27 mg); mp: 127−129 °C; R_f (30% EtOAc-Pet. ether) = 0.5; IR (Neat, cm^{-1}): 3075, 2951, 1590, 1595, 1219, 1101; ^1H NMR ($CDCl_3$, 400 MHz): δ 8.07−7.84 (m, 2H), 7.63 (dd, J = 8.3, 6.3 Hz, 1H), 7.56 (t, J = 7.4 Hz, 2H), 7.45−7.40 (m, 1H), 7.26 (dd, J = 6.8, 3.7 Hz, 2H), 7.16 (t, J = 7.6 Hz, 1H), 6.11 (s, 1H), 2.32 (s, 3H); $^{13}C\{^1H\}$ NMR ($CDCl_3$, 100 MHz): δ 148.5, 140.5, 136.8, 133.4, 132.2, 129.3, 129.1,125.8, 125.6, 125.02, 118.3, 99.3, 25.6; HRMS (ESI) (m/z): Calcd for $C_{15}H_{13}NOSH$ $[M + H]+$: 256.0796, found $[M + H]+$: 256.0798.

■ ASSOCIATED CONTENT

Ⓢ Supporting Information

The Supporting Information is available free of charge on the ACS Publications website at DOI: 10.1021/acs.joc.9b00743.

Optimization data, ^1H and ^{13}C NMR spectral data of all compounds, and X-ray crystallography data (PDF)

Crystallographic information for compound **4ai** (CIF)

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Notes

The authors declare no competing financial interest.

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J. Org. Chem. XXXX, XXX, XXX−XXX

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